State of California
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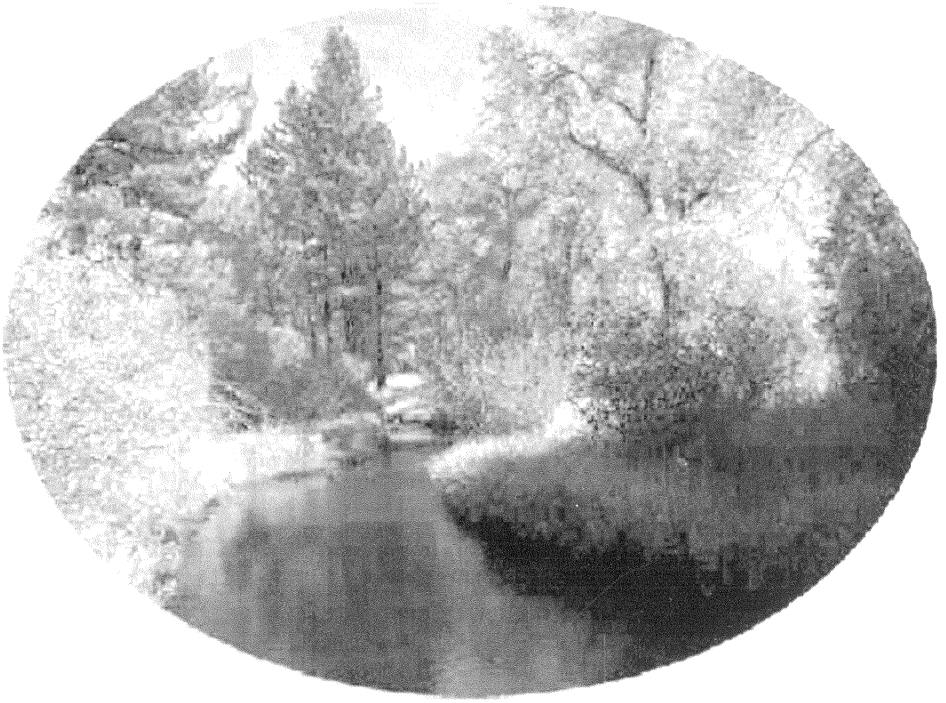
DEPARTMENT OF FISH AND GAME



STANDING STOCKS OF FISHES IN SECTIONS OF BIG GRIZZLY CREEK PLUMAS COUNTY, 1999

by

Charles J. Brown
Central Valley Bay-Delta Branch

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INTRODUCTION

The Department of Water Resources (DWR) initiated an instream flow program in 1976 to identify streams that would benefit from flow enhancement, to assess instream values, and identify actions such as habitat manipulation that could enhance these streams. The Northern District of the DWR selected Big Grizzly Creek below Lake Davis (Figure 1) as one of the streams to study under this program.

Previous sampling on Big Grizzly Creek has been conducted by Department of Fish and Game (DFG) biologists. Initial estimates of rainbow trout (Oncorhynchus mykiss) populations were made by the DFG in 1976 (Brown 1976). The DFG also surveyed the creek in 1981, 1986, 1988, 1991, 1994, 1995, 1996, 1997, and 1998 to estimate standing stocks of brown trout (Salmo trutta) and rainbow trout in selected stations (Bumpass et al. 1989, Brown 1991a, Brown 1991b, Brown 1992, Brown 1995, Brown 1996, Brown 1997, Brown 1998, and Brown 1999).

The purpose of this study is to evaluate the effects of the operation of Lake Davis on natural spawning populations of trout in Big Grizzly Creek through the periodic sampling of fish at established stations in that creek. These data may also be used to measure the recovery of the trout the DFG planted in Big Grizzly Creek following the rotenone treatment that was conducted in October 1998 to kill northern pike (Esox lucius) in Lake Davis.

The following species of fishes occur in Big Grizzly Creek: rainbow trout, brown trout, largemouth bass (Micropterus salmoides), and Sacramento sucker (Catostomus occidentalis).

METHODS

Physical Measurements

Standing stocks of fishes were estimated at four stations in Big Grizzly Creek in September 1999 (Figure 1). Stations were intentionally selected to be near stations sampled in previous DFG studies (Gerstung 1973). Markers had previously been placed in trees along the stream to identify station boundaries. Stations varied in length from 53.0 to 89.6 m (Appendix 1). The length and width of each station was measured with metric tape measures.

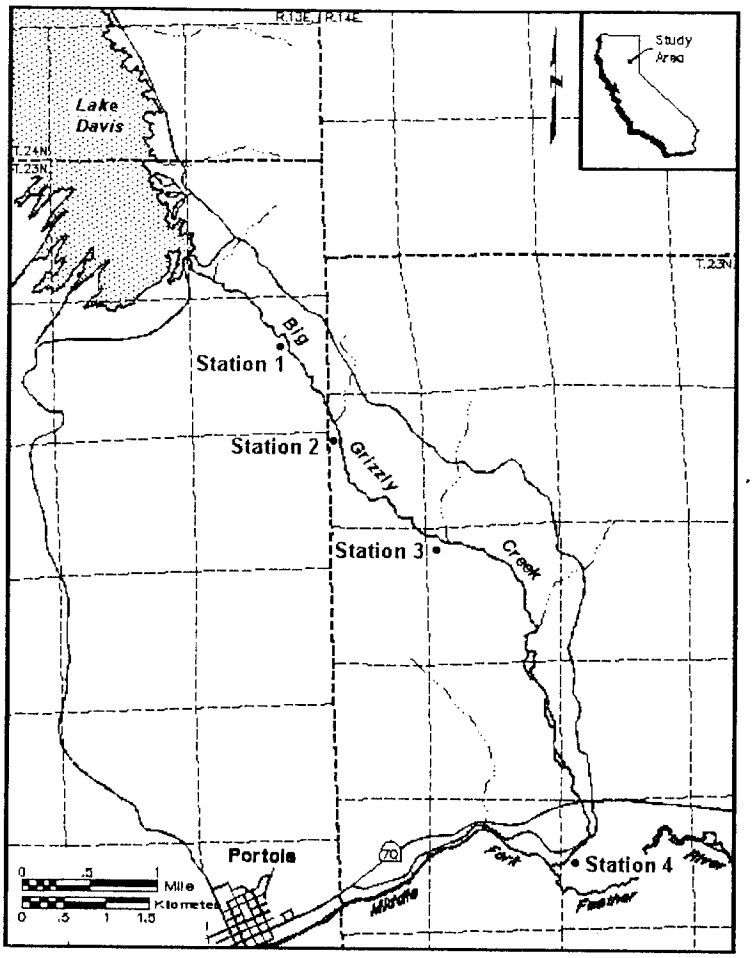

Figure 1 – Map of sampling stations in Big Grizzly Creek, Plumas County, 1999.

Biological Measurements

Fish were captured with a battery-powered backpack electroshocker in stream sections blocked by seines as described by Platts et al. (1983) (Figure 2). Captured fish were removed from the net-enclosed section on each pass. Standing stock estimates were developed using the two-count method of Seber and LeCren (1967) or the multiple-pass method of Leslie and Davis (1939) with limits of confidence computed using a formula proposed by DeLury (1951).

The weights of brown trout were measured by displacement (Figure 3). Fork length (FL) of each fish caught was measured to the nearest millimeter. Only brown trout were weighed and measured because we judged that all rainbow trout were of hatchery origin based on frayed fins, light coloration, and deciduous scales

Figure 2. Electrofishing in Big Grizzly Creek, Plumas County.

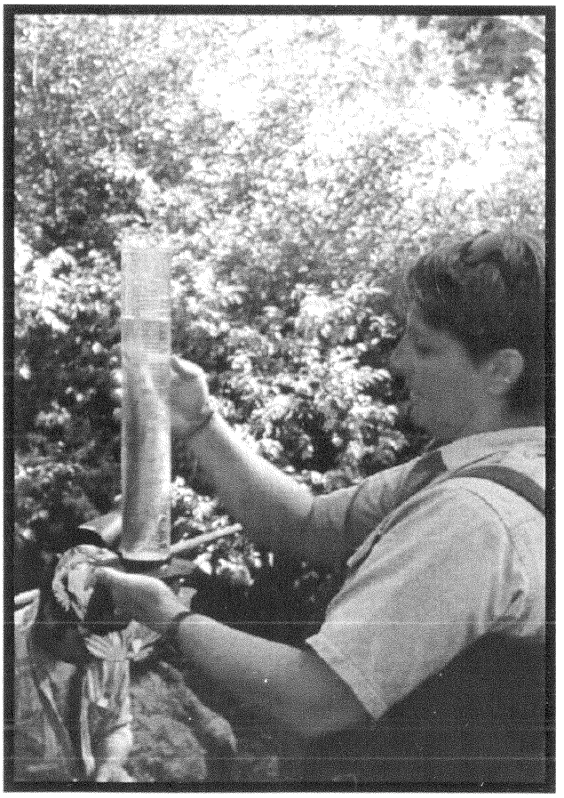

Figure 3. Measuring weights of trout by displacement.

Scale samples were taken from brown trout over 100 mm in length. Scales were taken just above the lateral line between the dorsal and adipose fin (Scarnecchia 1979) and placed in a piece of paper inserted in a small coin envelope (Drummond 1966). Scales were mounted dry between microscope slides, and their images were projected on a NCR microfiche reader at a magnification of 42x. Scale measurements for the calculation of growth were recorded to the nearest millimeter along the anterior radius of the anterior-posterior axis of the scale. Estimation of instantaneous population growth rate was calculated (Ricker 1975) with significant values of correlation coefficients taken from a table (Steel and Torrie 1960).

Instantaneous population growth rate = $b(\log_e l_2 - \log_e \log_1)$

b = between ages functional slope

l_1 = initial length for the last complete year of growth

l_2 = final length for the last complete year of growth

Standing crops of brown trout were calculated for individual stations where each species was caught and then combined for the entire creek. Age and growth were calculated for the population (Everhart et al. 1975). Length-weight relationships were determined for brown trout (Lagler 1956). The coefficient of condition and 95 percent confidence intervals were calculated for trout (Carlander 1969). The distribution of all fish caught is listed according to location.

RESULTS

Distribution

Rainbow trout and brown trout were caught at each station. Sacramento suckers were caught in station 3. Largemouth bass were caught in station 4, the lowest station sampled (Table 1).

Table 1. Distribution of fishes in sections of Big Grizzly Creek, Plumas County, 1999.

	Station Number			
	1	2	3	4
Brown trout	X	X	X	X
Rainbow trout	X	X	X	X
Sacramento sucker			X	

Largemouth bass				X

Standing Crop

We found brown trout in all four stations. Biomass of brown trout was 6.0 g/m^2 (Table 2). Catchable brown trout biomass averaged 5.9 g/m^2. Biomass was not estimated for Sacramento suckers.

Table 2. Estimates of brown trout standing crop in Big Grizzly Creek, Plumas County, 1999.

Distance below Grizzly Valley Dam (km)	Population Estimate	95 Percent Confidence Estimate	Biomass (g/m^2)	Estimate of Catchable Trout	Biomass of Catchable Trout (g/m^2)
1.8	6	6-7	2.3	6	2.3
3.1	22	22-24	7.0	19	6.9
5.2	5	5-6	4.2	5	4.2
10.4	100	73-139	10.5	24	10.2

Length and Weight

Age group 0+ brown trout made up 44 percent of the 106 brown trout caught. Age 1+ comprised 25 percent and age 2+ made up 21 percent. Age class 3+ brown trout made up 10 percent of the total catch (Figure 4 and Appendix 2).

The relationship between fork length and weight (W) of brown trout for Big Grizzly Creek is:

$$\text{Log}_{10} W = -4.9 + 3.0 \text{ Log}_{10} FL$$

$r^2 = 0.99$

$N = 106$ (Figure 5 and Appendix 2)

Age and Growth

The formula FL = 13.1 + 0.6 S describes the relationship between the fork length and enlarged scale radius (S) of 59 brown trout caught in Big Grizzly Creek. The coefficient of correlation (r^2) is 0.65.

Population growth was greater than individual growth for brown trout (Table 3).

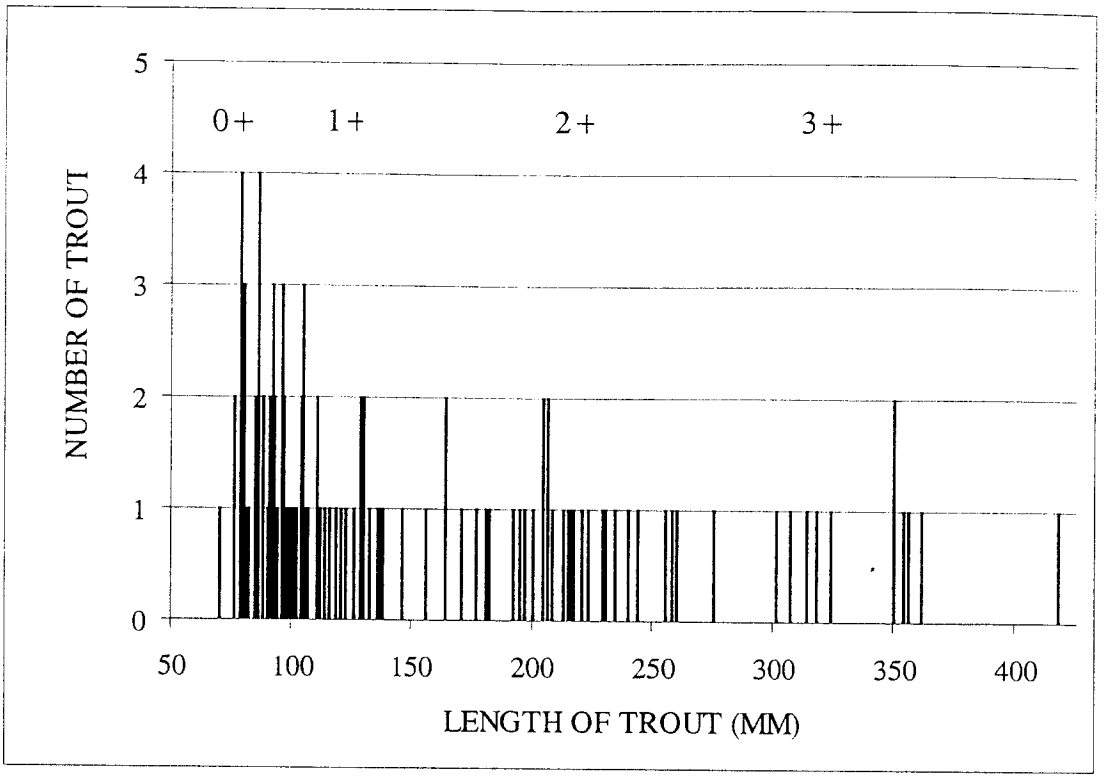

Figure 4. Length, observed frequency, and age of brown trout caught in Big Grizzly Creek, Plumas County, 1999

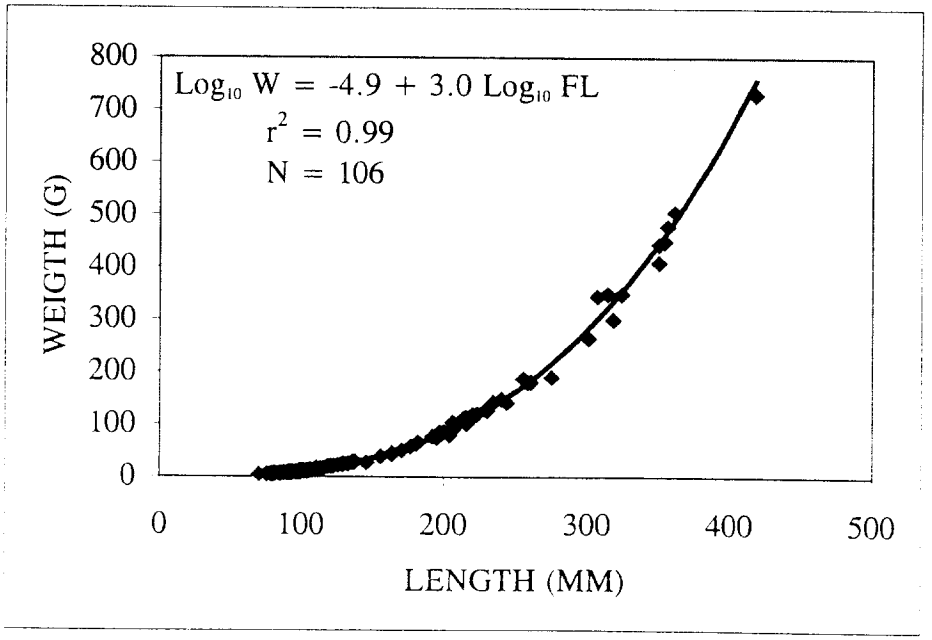

Figure 5. The relationship between length and weight of brown trout caught in sections of Big Grizzly Creek, Plumas County, 1999.

Table 3. Growth rates for brown trout caught in Big Grizzly Creek, Plumas County, 1999.

Age Interval	Population Growth			Mean Individual Growth		
	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate G_x	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate G_x
1-2	82-189	0.8350	2.5051	93-189	0.7091	2.1274
2-3	189-285	0.4107	1.2322	192-285	0.3950	1.1850

Age 1+ and age 2+ brown trout averaged 154 mm and 225 mm, respectively. Nine age 3+ brown trout averaged 335 mm fork length (Table 4).

Table 4. Calculated fork length of brown trout from Big Grizzly Creek, Plumas County, 1999.

Age	Number of Fish	Length at Capture (mm)	Calculated Lengths at Successive Annuli		
			1	2	3
1	18	154	82		
2	22	225	93	198	
3	9	335	90	192	285
Number of back-calculations			49	31	9
Weighted means (mm)			88	190	285
Increments (mm)				102	95

Coefficient of Condition

The average coefficient of condition for 106 brown trout was 1.0658. Age 0+ brown trout had slightly higher coefficients of condition than all other age groups (Table 5).

Table 5. Condition of brown trout in Big Grizzly Creek, Plumas County, 1999.

Age	Number of Fish	Coefficient of Condition	95% Confidence Interval
0+	46	1.0652	0.8660-1.2643
1+	27	1.0850	0.9216-1.2483
2+	22	1.0587	0.9228-1.1946
3+	11	1.0357	0.8933-1.1781
Combined	106	1.0658	0.8906-1.2410

DISCUSSION

Summer streamflow in Big Grizzly Creek has generally been between 0.6 and 0.3 cms from 1974 to 1999. Higher flows occurred in 1977 and 1979 (Table 6). Haines (1982) reported that optimum flow for rainbow trout was 0.6 cms. Her recommendation was based on an instream flow study that the DWR conducted in 1981. The DWR bases flow releases from Lake Davis on lake water levels in the spring. Lake water levels were low from 1988 through 1994 so minimum releases (0.3 cms) were the rule.

Table 6. Average summer streamflow in Big Grizzly Creek, 1974-1999.

Year	Flow (cms)	Year	Flow (cms)
1974	0.7	1987	0.5
1975	0.4	1988	0.3
1976	0.3	1989	0.3
1977	1.8	1990	0.3
1978	0.3	1991	0.3
1979	2.2	1992	0.3
1980	0.4	1993	0.3
1981	0.3	1994	0.3
1982	0.6	1995	0.6
1983	0.6	1996	0.6
1984	0.6	1997	0.6
1985	0.5	1998	0.6

1986	0.6	1999	0.6

Biomass of rainbow trout has averaged 3.2 g\m^2 and ranged from 1.0 to 7.3 g\m^2 since we began sampling in 1976 (Table 7). There is no significant correlation between streamflow and biomass ($r^2 = 0.001$) because rainbow trout biomass was lower in 1986 and 1995 than we expected from the relative high summer flows that were released that year. Brown trout biomass has averaged 1.9 g/m^2 and ranged from 0 to 6.0 g/m^2. Brown trout biomass is not correlated with flow ($p>0.05$)

Table 7. Biomass of rainbow and brown trout in Big Grizzly Creek, 1977-1999.

	Rainbow Trout Biomass (g/m^2)	Brown Trout Biomass (g/m^2)
1976	1.9	0
1981	1.8	0.1
1986	3.2	3.8
1988	5.6	0.4
1994	2.2	0.7
1995	1.0	0.5
1996	4.5	0.5
1997	7.3	2.2
1998	1.6	3.1
1999	0	6.0
Mean	3.2	1.9

Density of all brown trout (Table 8) and density of catchable-size brown trout (Table 9) were greater than average for the last two years. This does not reflect the improved habitat created by five years of favorable flow as much as the fact that many brown trout were planted by the DFG in 1998 and 1999 to restock Big Grizzly Creek following the virtual elimination of all trout by rotenone. The DFG transplanted brown trout from Indian Creek, Plumas County to stock Big Grizzly Creek following the rotenone treatment in October 1998.

Table 8. Density of rainbow and brown trout (trout/m^2) Big Grizzly Creek, 1981-1999.

Year	Rainbow Trout	Brown Trout
1981	0.02	0.03
1988	0.13	0.01
1991	0.20	0.01
1994	0.06	0.04
1995	0.05	0.02
1996	0.11	0.11
1997	0.21	0.07
1998	0.12	0.12
1999	0	0.10
Mean	0.11	0.06

Table 9. Density of catchable-size rainbow and brown trout (trout/m^2) in Big Grizzly Creek.

Year	Rainbow Trout	Brown Trout
1981	0.01	0
1986	0.02	0.08
1988	0.09	0.02
1994	0.02	0.02
1995	0.03	0.01
1996	0.04	0.01
1997	0.05	0.01
1998	0.01	0.02
1999	0	0.04
Mean	0.03	0.02

Growth of brown trout in 1999 was the highest we have recorded since we started to sample in 1981 (Table 10). The previous low growth of these trout may be due to lack of insects they eat. Rotenone killed insects in October 1998 and they may have been slow to recolonize (Cook and Moore 1969). It may also be due to the hatchery trout that the DFG planted. They grow slowly in a new environment (Mason et al. 1967, Fay and Pardue 1986). However, some of these trout have been in the stream for over one year. They have had time to adjust to their new environment. Insects have had time to recolonize the stream. Increased availability of food and better adjustment to the new environment may be responsible for the increased growth that was evident this year.

Table 10. Growth of age 1-2 rainbow and brown trout in Big Grizzly Creek.

Year	Rainbow Trout	Brown Trout
1981	1.892	-
1986	1.416	-
1988	1.534	1.534
1994	1.747	1.888
1995	2.219	2.429
1996	1.973	2.273
1997	2.289	2.298
1998	1.233	1.420
1999	-	2.505
Mean	1.789	2.050

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APPENDIX 1

PERMANENT FISH POPULATION STATIONS FOR
BIG GRIZZLY CREEK, PLUMAS COUNTY
SEPTEMBER, 1999

Station 1 (Stream Gage Station) - Station 1 is located 1.8 stream km below Grizzly Valley Dam and just downstream from an abandoned USGS stream gage at an elevation of 1622 m MSL. The station begins at a concrete weir near a stream gage (UTM 170 167). The stream within the station is a riffle (67%) with several split channels and small pocket pools that ends in a long, shallow pool (33%). It is 60.7 m long and has a surface area of 384.8 m^2 at 0.56 cms. Substrate is 75% boulders, 15% rubble, and 10% sand.

Station 2 (IFN Station) - Station 2 is 3.1 stream km below Grizzly Valley Dam. The site located at UTM 176 156 at an elevation of 1610 m MSL. The upper end of the station is a steep rapid (55%) followed by two deep pools (45%) separated by short rapids. The substrate is mostly rubble (60%), boulder (20%), gravel (10%), with areas of sand (10%) in the pools. The station is 56.7 m long with a surface area of 206.7 m^2 at 0.56 cms.

Station 3 (3-Mile Station) - Station 3 is located 5.2 km downstream from Grizzly Valley Dam at an elevation of 1549 m MSL at UTM 189 141. The station begins in a steep rapid followed by more gradual rapids (75%) with pocket pools and two larger pools (25%) near the lower end. Substrate is boulder (65%), rubble (20%), sand (10%), and gravel (5%). The station is 53.0 m long and has a surface area of 287 m^2 at 0.56 cms.

Station 4 (6-Mile Station) - Station 4 is located 10.4 km below Grizzly Valley Dam and 0.2 km above the confluence with the Middle Fork Feather River at an elevation of 1488 m MSL. It is located at UTM 205 106. The station begins in a rapid just above a large 0.7 m deep pool (33%) followed by several riffle areas (67%) and shallow pools with undercut banks and overhanging grass clumps. Substrate is rubble (10%), gravel (75%), bedrock (10%), and mud (5%). The station is 89.6 m long with a surface area of 466.8 m^2 at 0.56 cms.

APPENDIX 2

LENGTH AND WEIGHT OF BROWN TROUT CAUGHT IN BIG GRIZZLY CREEK, 1999

LENGTH	WEIGHT	LENGTH	WEIGHT	LENGTH	WEIGHT	LENGTH	WEIGHT
70	4	94	9	129	24	220	119
76	5	96	9	130	25	223	120
76	5	96	9	130	25	229	129
79	6	96	9	133	25	230	127
79	4	97	9	136	28	234	143
79	4	97	9	137	28	240	149
79	5	98	8	138	29	244	142
80	6	99	12	146	27	255	187
80	6	100	11	156	39	258	181
80	5	101	12	164	46	260	181
81	6	102	11	164	43	275	190
82	7	104	12	171	51	301	265
85	7	104	11	177	58	307	345
85	7	105	11	181	64	314	350
86	7	105	12	182	66	318	300
86	6	105	12	192	77	324	350
86	7	106	13	195	74	350	444
86	6	107	13	197	86	350	409
88	8	111	18	200	86	354	450
88	8	111	14	204	80	356	478
90	8	112	14	204	80	361	505
91	9	114	16	206	104	418	730
91	8	116	16	206	89		
92	8	119	20	208	96		
92	8	121	21	213	110		
92	8	123	21	215	115		
93	8	126	23	216	102		
93	9	129	25	217	107		